

## CLAIMS

I/We claim:

- [c1] 1. A contact assembly for use in an electrochemical deposition system to apply an electrical potential to a microelectronic workpiece, comprising:
  - a support member having an inner wall defining an opening configured to receive the workpiece; and
  - a plurality of contacts including a conductor and a cover, the conductor comprising a proximal section projecting inwardly into the opening relative to the support member, a distal section extending from the proximal section, and an inert exterior at least at the distal section, and the cover comprising a dielectric material covering at least the proximal section of the conductor.
- [c2] 2. The contact assembly of claim 1 wherein:
  - the support member comprises a conductive ring defining a conductive element, a dielectric exterior, and a plurality of turrets;
  - the covers of the contacts comprise dielectric sheaths, and wherein the sheaths have a bore and project from the turrets; and
  - the conductors of the contacts comprise rods having a first section received in the bore of a cover and a second section projecting outside of the cover.
- [c3] 3. The contact assembly of claim 1 wherein:
  - the support member comprises a dielectric ring having a conductive bus and a plurality of turrets;
  - the covers of the contacts comprise dielectric sheaths, and wherein the sheaths have a bore and project from the turrets; and

the conductors of the contacts comprise rods having a first section received in the bore of a cover and a second section projecting outside of the cover, and wherein the rods are electrically coupled to the conductive bus in the ring.

[c4]

4. The contact assembly of claim 1 wherein:  
the support member comprises a ring having a conductive element and a plurality of turrets;  
the covers of the contacts comprise dielectric sheaths, and wherein the sheaths have a bore and project from the turrets at an angle swept relative to a radius of the ring; and  
the conductors of the contacts comprise rods having a first section received in the bore of a cover and a second section projecting outside of the cover.

[c5]

5. The contact assembly of claim 1 wherein:  
the support member comprises a ring having a conductive element and a plurality of turrets;  
the covers of the contacts comprise dielectric sheaths, and wherein the sheaths have a bore and project inwardly and upwardly from the turrets; and  
the conductors of the contacts comprise rods having a first section received in the bore of a cover and a second section projecting outside of the cover.

[c6]

6. The contact assembly of claim 1 wherein:  
the covers of the contacts comprise dielectric sheaths, and wherein the sheaths have a bore and project from the support member; and

the conductors of the contacts comprise rods having a first section received in the bore of a cover and a second section projecting inwardly from the cover.

- [c7]        7.      The contact assembly of claim 1 wherein:  
the covers of the contacts comprise dielectric sheaths;  
the conductors comprise rods received in the sheaths; and  
a plurality of boots cover corresponding turrets.
- [c8]        8.      The contact assembly of claim 1 wherein the conductors each have an aperture through which a gas can flow.
- [c9]        9.      The contact assembly of claim 1 wherein the contacts are coupled to the support member by a positionable connector that allows the contacts to swivel with respect to the support member.
- [c10]       10.     The contact assembly of claim 1 wherein the covers of the contacts comprise dielectric sheaths having a bore.
- [c11]       11.     The contact assembly of claim 1 wherein the conductors comprise rods composed of platinum or a platinum/iridium alloy.
- [c12]       12.     The contact assembly of claim 1 wherein the conductors comprise titanium rods having a platinum coating.
- [c13]       13.     The contact assembly of claim 1 wherein the conductors comprise stainless steel rods.
- [c14]       14.     The contact assembly of claim 1 wherein the conductors comprise tungsten rods.

[c15] 15. The contact assembly of claim 1 wherein the conductors comprise tungsten rods having a platinum coating.

[c16] 16. A contact assembly for use in an electrochemical deposition system to apply an electrical potential to a microelectronic workpiece, comprising:

a support member having an inner wall defining an opening configured to receive the workpiece, a dielectric exterior, and an electrically conductive element within the dielectric exterior; and

a contact system having a plurality of contacts projecting inwardly into the opening relative to the support member, the contacts including a conductor having a contact site with an inert surface and a dielectric cover over at least a portion of the conductor, and the conductor being electrically coupled to the conductive element of the support member.

[c17] 17. The contact assembly of claim 16 wherein:

the covers of the contacts comprise dielectric sheaths, and wherein the sheaths have a bore and project from the support member; and  
the conductors of the contacts comprise rods having a proximal section received in the bore of a cover and a distal end projecting inwardly from the cover.

[c18] 18. The contact assembly of claim 16 wherein the covers of the contacts comprise dielectric sheaths having a bore.

[c19] 19. The contact assembly of claim 16 wherein the conductors comprise platinum rods.

[c20] 20. The contact assembly of claim 16 wherein the conductors comprise titanium rods having a platinum coating.

- [c21] 21. The contact assembly of claim 16 wherein:  
the support member comprises a ring and a plurality of turrets;  
the covers of the contacts comprise dielectric sheaths, and wherein the  
sheaths have a bore and project from the turrets at an angle swept  
relative to a radius of the ring; and  
the conductors of the contacts comprise rods having a proximal section  
received in the bore of a cover and a distal end projecting outside of  
the cover.
- [c22] 22. The contact assembly of claim 16 wherein:  
the support member comprises a ring and a plurality of turrets;  
the covers of the contacts comprise dielectric sheaths, and wherein the  
sheaths have a bore and project inwardly and upwardly from the  
turrets; and  
the conductors of the contacts comprise rods having a proximal section  
received in the bore of a cover and a distal end projecting outside of  
the cover.
- [c23] 23. A contact assembly for use in an electrochemical deposition system  
to apply an electrical potential to a microelectronic workpiece, comprising:  
a ring having an inner wall defining an opening configured to receive the  
workpiece; and  
a plurality of contacts projecting inwardly from the ring into the opening, the  
contacts comprising a dielectric element and a conductor having a  
first section in the dielectric element and a second section exposed  
relative to the dielectric element, and wherein at least the second  
section of the conductor has an inert exterior.

- [c24] 24. The contact assembly of claim 23 wherein:  
the ring has a conductive element, a dielectric exterior, and a plurality of turrets;  
the dielectric elements comprise sheaths that have a bore and project from the turrets; and  
the conductors of the contacts comprise rods having a proximal section received in the bore of a cover and a distal end projecting inwardly from the cover.
- [c25] 25. The contact assembly of claim 23 wherein:  
the ring has a dielectric body, a conductive bus carried by the body, and a plurality of turrets;  
the dielectric elements comprise sheaths that have a bore and project from the turrets; and  
the conductors of the contacts comprise rods having a proximal section received in the bore of a sheath and a distal end projecting inwardly from the sheath, and wherein the rods are electrically coupled to the conductive bus in the ring.
- [c26] 26. The contact assembly of claim 23 wherein:  
the ring has a conductive element and a plurality of turrets;  
the dielectric elements comprise sheaths that have a bore and project from the turrets at an angle swept relative to a radius of the ring; and  
the conductors of the contacts comprise rods partially received in the sheaths.
- [c27] 27. The contact assembly of claim 23 wherein:  
the ring has a conductive element and a plurality of turrets;  
the dielectric elements comprise sheaths that have a bore and project inwardly and upwardly from the turrets; and

the conductors of the contacts comprise rods partially received in the sheaths.

[c28] 28. The contact assembly of claim 23 wherein:  
the dielectric elements comprise sheaths that have a bore and project from  
the support member; and

the conductors of the contacts comprise rods having a proximal section  
received in the sheaths and a distal end projecting from the sheaths.

[c29] 29. The contact assembly of claim 23 wherein the dielectric elements  
comprise sheaths having a bore.

[c30] 30. The contact assembly of claim 23 wherein the conductors comprise  
platinum rods.

[c31] 31. The contact assembly of claim 23 wherein the conductors comprise  
titanium rods having a platinum coating.

[c32] 32. The contact assembly of claim 23 wherein the conductors comprise  
stainless steel rods.

[c33] 33. The contact assembly of claim 23 wherein the conductors comprise  
tungsten rods.

[c34] 34. A contact assembly for use in an electrochemical deposition system  
to apply an electrical potential to a microelectronic workpiece, comprising:  
a support member having a ring including an inner wall defining an opening  
configured to receive the workpiece and a plurality of turrets  
depending downwardly;

a plurality of dielectric sheaths coupled to the support member, wherein each sheath has a bore and projects from a corresponding turret inwardly into the opening; and  
a plurality of conductors having a first section, a second section, and an inert exterior on at least the second section, wherein at least the first section of each conductor is received in the bore of a sheath.

[c35] 35. The contact assembly of claim 34 wherein the conductors comprise platinum rods.

[c36] 36. The contact assembly of claim 34 wherein the conductors comprise titanium rods having a platinum coating.

[c37] 37. The contact assembly of claim 34 wherein the conductors comprise stainless steel rods.

[c38] 38. The contact assembly of claim 34 wherein the conductors comprise tungsten rods.

[c39] 39. A reactor for electrochemical deposition processing of a microelectronic workpiece, comprising:

a vessel configured to hold a processing solution;  
an electrode disposed relative to the vessel to provide an electrical potential in the vessel;

a head assembly moveable relative to the vessel between a load/unload position and a processing position; and

a contact assembly carried by the head assembly, wherein the contact assembly comprises -

a support member having an inner wall defining an opening configured to receive the workpiece; and

a plurality of contacts including a conductor and a cover, the conductor comprising a proximal section projecting inwardly into the opening relative to the support member, a distal section extending from the proximal section, and an inert exterior at least at the distal section, and the cover comprising a dielectric element covering at least the proximal section of the conductor.

- [c40] 40. The reactor of claim 39 wherein:  
the support member comprises a ring having a conductive element and a plurality of turrets;  
the covers of the contacts comprise dielectric sheaths, and wherein the sheaths have a bore and project from the turrets; and  
the conductors of the contacts comprise rods having a first section received in the bore of a cover and a second section projecting inwardly from the cover.
- [c41] 41. The reactor of claim 39 wherein:  
the support member comprises a dielectric ring having a conductive bus and a plurality of turrets;  
the covers of the contacts comprise dielectric sheaths, and wherein the sheaths have a bore and project from the turrets; and  
the conductors of the contacts comprise rods having a first section received in the bore of a cover and a second section projecting inwardly from the cover, and wherein the rods are electrically coupled to the conductive bus in the ring.
- [c42] 42. The reactor of claim 39 wherein:  
the support member comprises a ring having a conductive element and a plurality of turrets;

the covers of the contacts comprise dielectric sheaths, and wherein the sheaths have a bore and project from the turrets at an angle swept relative to a radius of the ring; and

the conductors of the contacts comprise rods having a first section received in the bore of a cover and a second section projecting inwardly from the cover.

[c43] 43. The reactor of claim 39 wherein:

the support member comprises a ring having a conductive element and a plurality of turrets;

the covers of the contacts comprise dielectric sheaths, and wherein the sheaths have a bore and project inwardly and upwardly from the turrets; and

the conductors of the contacts comprise rods having a first section received in the bore of a cover and a second section projecting inwardly from the cover.

[c44] 44. The reactor of claim 39 wherein:

the covers of the contacts comprise dielectric sheaths, and wherein the sheaths have a bore and project from the support member; and

the conductors of the contacts comprise rods having a first section received in the bore of a cover and a second section projecting inwardly from the cover.

[c45] 45. A reactor for electrochemical deposition processing of a microelectronic workpiece, comprising:

a vessel configured to hold a processing solution;

an electrode disposed relative to the vessel to provide an electrical potential in the vessel;

a head assembly moveable relative to the vessel between a load/unload position and a processing position; and

a contact assembly carried by the head assembly, wherein the contact assembly comprises -

a support member having an inner wall defining an opening configured to receive the workpiece and an electrically conductive element; and

a contact system having a plurality of contacts projecting inwardly into the opening relative to the support member, the contacts including a conductor having a contact site with an inert surface and a dielectric cover over at least a portion of the conductor, and the conductor being electrically coupled to the conductive element of the support member.

- [c46] 46. The reactor of claim 45 wherein:  
the covers of the contacts comprise dielectric sheaths, and wherein the sheaths have a bore and project from the support member; and  
the conductors of the contacts comprise rods having a proximal section received in the bore of a cover and a distal end projecting inwardly from the cover.
- [c47] 47. The reactor of claim 45 wherein the covers of the contacts comprise dielectric sheaths having a bore.
- [c48] 48. The reactor of claim 45 wherein the conductors comprise platinum rods.
- [c49] 49. The reactor of claim 45 wherein the conductors comprise titanium rods having a platinum coating.

- [c50] 50. The reactor of claim 45 wherein:  
the support member further comprises a ring having the conductive element and a plurality of turrets;  
the covers of the contacts comprise dielectric sheaths, and wherein the sheaths have a bore and project from the turrets at an angle swept relative to a radius of the ring; and  
the conductors of the contacts comprise rods having a proximal section received in the bore of a cover and a distal end projecting inwardly from the cover.
- [c51] 51. The reactor of claim 45 wherein:  
the support member further comprises a ring having the conductive element and a plurality of turrets;  
the covers of the contacts comprise dielectric sheaths, and wherein the sheaths have a bore and project inwardly and upwardly from the turrets; and  
the conductors of the contacts comprise rods having a proximal section received in the bore of a cover and a distal end projecting inwardly from the cover.
- [c52] 52. A reactor for electrochemical deposition processing of a microelectronic workpiece, comprising:  
a vessel configured to hold a processing solution;  
an electrode disposed relative to the vessel to provide an electrical potential in the vessel;  
a head assembly moveable relative to the vessel between a load/unload position and a processing position; and  
a contact assembly carried by the head assembly, wherein the contact assembly comprises -

a ring having an inner wall defining an opening configured to receive the workpiece; and

a plurality of contacts projecting inwardly from the ring into the opening, the contacts comprising a dielectric element and a conductor having a first section in the dielectric element and a second section exposed relative to the dielectric element, and wherein at least the second section of the conductor has an inert exterior.

[c53] 53. A reactor for electrochemical deposition processing of a microelectronic workpiece, comprising:

a vessel configured to hold a processing solution;

an electrode disposed relative to the vessel to provide an electrical potential in the vessel;

a head assembly moveable relative to the vessel between a load/unload position and a processing position; and

a contact assembly carried by the head assembly, wherein the contact assembly comprises -

a support member having a ring including an inner wall defining an opening configured to receive the workpiece and a plurality of turrets depending downwardly;

a plurality of dielectric sheaths coupled to the support member, wherein each sheath has a bore and projects from a corresponding turret inwardly into the opening; and

a plurality of conductors having a first section, a second section, and an inert exterior on at least the second section, wherein at least the first section of each conductor is received in the bore of a sheath.

[c54]        54. The reactor of claim 53 wherein the conductors comprise platinum rods.

[c55]        55. The reactor of claim 53 wherein the conductors comprise titanium rods having a platinum coating.

[c56]        56. The reactor of claim 53 wherein the conductors comprise stainless steel rods.

[c57]        57. The reactor of claim 53 wherein the conductors comprise tungsten rods.

[c58]        58. A tool for electrochemical processing of a microelectronic workpiece, comprising:

    a cabinet;

    a transfer mechanism; and

    an electroplating reactor in the cabinet comprising a vessel configured to hold a processing solution, an electrode disposed relative to the vessel to provide an electrical potential in the vessel, a head assembly moveable relative to the vessel between a load/unload position and a processing position, and a contact assembly carried by the head assembly, wherein the contact assembly comprises -

    a support member having an inner wall defining an opening configured to receive the workpiece; and

    a plurality of contacts including a conductor and a cover, the conductor comprising a proximal section projecting inwardly into the opening relative to the support member, a distal section extending from the proximal section, and an inert exterior at least at the distal section, and the cover

comprising a dielectric material covering at least the proximal section of the conductor.

[c59] 59. The tool of claim 58 wherein:

the support member comprises a ring having a conductive element, a dielectric exterior, and a plurality of turrets;  
the covers of the contacts comprise dielectric sheaths, and wherein the sheaths have a bore and project from the turrets; and  
the conductors of the contacts comprise rods having a first section received in the bore of a cover and a second section projecting away from the cover.

[c60] 60. The tool of claim 58 wherein:

the support member comprises a dielectric ring having a conductive bus and a plurality of turrets;  
the covers of the contacts comprise dielectric sheaths, and wherein the sheaths have a bore and project from the turrets; and  
the conductors of the contacts comprise rods having a first section received in the bore of a cover and a second section projecting inwardly from the cover, and wherein the rods are electrically coupled to the conductive bus in the ring.

[c61] 61. The tool of claim 58 wherein:

the support member comprises a ring having a conductive element and a plurality of turrets;  
the covers of the contacts comprise dielectric sheaths, and wherein the sheaths have a bore and project from the turrets at an angle swept relative to a radius of the ring; and

the conductors of the contacts comprise rods having a first section received in the bore of a cover and a second section projecting away from the cover.

- [c62] 62. The tool of claim 58 wherein:  
the support member comprises a ring having a conductive element and a plurality of turrets;  
the covers of the contacts comprise dielectric sheaths, and wherein the sheaths have a bore and project inwardly and upwardly from the turrets; and  
the conductors of the contacts comprise rods having a first section received in the bore of a cover and a second section projecting inwardly from the cover.
- [c63] 63. The tool of claim 58 wherein:  
the covers of the contacts comprise dielectric sheaths, and wherein the sheaths have a bore and project from the support member; and  
the conductors of the contacts comprise rods having a first section received in the bore of a cover and a second section projecting inwardly from the cover.
- [c64] 64. The tool of claim 58 wherein the covers of the contacts comprise dielectric sheaths having a bore.
- [c65] 65. The tool of claim 58 wherein the conductors comprise platinum rods.
- [c66] 66. The tool of claim 58 wherein the conductors comprise titanium rods having a platinum coating.

[c67]        67. The tool of claim 58 wherein the conductors comprise stainless steel rods.

[c68]        68. The tool of claim 58 wherein the conductors comprise tungsten rods.

[c69]        69. A tool for electrochemical processing of a microelectronic workpiece, comprising:

    a cabinet;

    a transfer mechanism; and

    an electroplating reactor in the cabinet comprising a vessel configured to hold a processing solution, an electrode disposed relative to the vessel to provide an electrical potential in the vessel, a head assembly moveable relative to the vessel between a load/unload position and a processing position, and a contact assembly carried by the head assembly, wherein the contact assembly comprises -  
    a support member having a ring including an inner wall defining an opening configured to receive the workpiece and a plurality of turrets depending downwardly;

    a plurality of dielectric sheaths coupled to the support member, wherein each sheath has a bore and projects from a corresponding turret inwardly into the opening; and

    a plurality of conductors having a first section, a second section, and an inert exterior on at least the second section, wherein at least the first section of each conductor is received in the bore of a sheath.

[c70]        70. The tool of claim 69 wherein the conductors comprise platinum rods.

[c71]        71. The tool of claim 69 wherein the conductors comprise titanium rods having a platinum coating.

[c72]        72. The tool of claim 69 herein the conductors comprise stainless steel rods.

[c73]        73. The tool of claim 69 herein the conductors comprise tungsten rods.

[c74]        74. A method of manufacturing a contact assembly for electrochemical processing of microelectronic workpieces, comprising:  
              covering a portion of a conductor with a dielectric cover to leave an exposed contact site on the conductor; and  
              attaching the cover and/or the conductor to a support ring so that the conductor projects into an opening of the support ring.